REMARKS

I. Summary of the Examiner's Action

A. Claim Rejections

Claims 1 – 16, 18 and 21 – 23 stand rejected under 35 U.S.C. § 102(e) as being anticipated by United States Patent Application Publication No. 2002/0097750 to Gunaseelan *et al.* (hereinafter "Gunaseelan" or "the Gunaseelan application").

Claims 17, 19 and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the Gunaseelan application in view of United States Patent No. 6,842, 433 to West *et al.* (hereinafter "the West patent").

These rejections are respectfully disagreed with and traversed below.

II. Applicant's Response

A. Claim Amendments

Applicants have amended the claims. These claim amendments add no new matter.

Support for claim 1 and the other independent claims, as amended, and the new independent claims can be found throughout the application as filed; *see*, for example, FIG. 2; page 7, lines 9 – 12; page 8, lines 13 – 15, 19 – 20; page 9, lines 9 – 10; page 10,

lines 11 – 31; page 12, lines 1 – 16; page 14, line 31 – page 15, line 1; and page 15, lines 6 – 8.

Support for dependent claim 3 and similar dependent claims, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 11, lines 3 – 8.

Support for dependent claim 4 and similar dependent claims, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 12, lines 18 – 22.

Support for dependent claim 5 and similar dependent claims, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 14, lines 22 – 25.

Support for dependent claim 6 and similar dependent claims, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 14, lines 22 – 25.

Support for dependent claim 7 and similar dependent claims, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 13, lines 4 – 32; page 14, lines 11 - 15.

Support for dependent claim 11 and similar dependent claims, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 14, lines 22 – 25.

Support for dependent claim 13 and similar dependent claims, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 15, lines 6 – 10.

Support for dependent claim 15 and similar dependent claims as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 7, lines 27 – 31.

Support for dependent claim 23, as amended, and similar new claims can be found throughout the application as filed; *see*, for example, page 4, lines 19 – 25.

Support for new dependent claim 24 and similar dependent claims can be found throughout the application as filed; *see*, for example, page 11, lines 21 – 32; page 12, lines 4 – 9.

Support for new dependent claim 25 and similar dependent claims can be found throughout the application as filed; *see*, for example, page 12, lines 27 – 29.

Support for new dependent claim 26 and similar dependent claims can be found throughout the application as filed; *see*, for example, page 12, lines 30 – 32.

Support for new dependent claim 27 and similar dependent claims can be found throughout the application as filed; *see*, for example, page 12, line 32 – page 13, line 2.

Support for new dependent claim 28 and similar dependent claims can be found throughout the application as filed; *see*, for example, page 15, lines 6 – 12.

Support for new dependent claim 29 and similar dependent claims can be found throughout the application as filed; *see*, for example, page 4, lines 19 – 25.

Support for new dependent claim 49 and similar dependent claims can be found throughout the application as filed; *see*, for example, page 13, lines 23 – 26.

B. The Gunaseelan Application

The Gunaseelan application discloses a streaming content delivery system comprising a number of clients (104) and a streaming server (102). The streaming server (102) comprises a number of packet producers (202), which acquire data to be streamed to the clients and produce time-stamped packets for delivery (*See* Gunaseelan, paragraph 0027, lines 8 - 11). The time-stamped packets produced by each packet producer are sent

from the packet producer to a time-stamped packet queue (204), a data structure that organizes the time-stamped packets into a first in, first out queue (*See* Gunaseelan, paragraph 0028, lines 1 - 4). A feeder module (206) removes the packets from the queue and delivers them to the client according to the time-stamp on each packet.

According to the Gunaseelan application, the feeder module can be adapted to accommodate certain special cases that may occur during streaming of media data. One particular special case involves a situation where two or more packets (possibly from different streams) need to be delivered at precisely the same time (*See* Gunaseelan, paragraph 0034, lines 1 - 5). In this case, the time-stamps of the conflicting packets are adjusted within an acceptable range so that the time-stamps no longer conflict (*See* Gunaseelan, paragraph 0038, lines 1 - 4).

According to Gunaseelan, the "acceptable range" within which the time-stamps of packets can be adjusted is based on certain buffering parameters of the client device. More specifically, embodiments of Gunaseelan's system allow a packet's time-stamp to be adjusted based on the client side pre-read size and/or maximum buffer size parameters (*See* Gunaseelan, paragraph 0040, lines 1 - 3), where the term "client side pre-read size" refers to the amount of data pre-read before playout starts at the client (*See* Gunaseelan, paragraph 0039, lines 4 - 6).

In particular, the server (102) can query the client (104) for values corresponding to the client's pre-read size and maximum buffer size parameters (*See* Gunaseelan, paragraph 0040, lines 5 - 7). If, for example, the client (104) pre-reads one second's worth of data, then a packet going to that client can be delayed up to a maximum of one second. Also, if the client has a maximum buffer size that can hold up to 10 seconds' worth of data, a packet can be sent to the client as early as 10 seconds ahead of its time-stamp (*See* Gunaseelan, paragraph 0040, lines 7 - 13).

Thus, knowing the client's pre-read size and maximum buffer size gives the server a certain degree of flexibility to delay or advance the transmission of data packets to the client, thereby providing a mechanism for resolving packet time-stamp conflicts.

C. Rejection of Claims 1 – 16, 18 and 21 – 23 under 35 U.S.C. § 102(e)

The claims of the present application have been amended to distinguish more clearly from the teachings of Gunaseelan. In particular, all the independent claim now recite a "*buffering algorithm, behavior of the buffering algorithm being affected by a pre-decoder initial buffering time and a minimum pre-decoder buffer size, the minimum pre-decoder buffer size corresponding to a minimum size of the pre-decoder buffer required to provide substantially correct playback of the media data at the client device when the data packet stream is transmitted over a constant-delay reliable transmission network*".

The teachings of Gunaseelan concentrate on the scheduling of data packets from a server to a client and, in particular, concern a mechanism for handling the problem of time-stamp conflicts which arise when different data packets (perhaps belonging to different data streams) are scheduled for transmission from the server at exactly the same time.

The present invention, on the other hand, as defined by the newly amended claims, is directed towards totally different issues.

As described in the present application, when data packets are streamed over a packet-based data transmission network from a server to client device, a certain amount of delay jitter occurs, due to the fact that the transmission network typically employs "best-effort" transmission protocols that cannot guarantee a constant transmission delay (*See* Application, page 1, line 12 – page 2, line 11). As stated at page 1, lines 16 – 19 of the Application, the reception interval of two packets may not be the same as their presentation interval and so multimedia terminals typically buffer received data for a short period in order to smooth out such delay variation.

In addition to variations in the rate at which data packets are received at the client device as a result of varying network delay, the received data rate may also fluctuate due to the fact that the compression efficiency achievable in some media types, such as video, depends on the contents of the source data. Considering the streaming of video data in

more detail, the aforementioned encoding-related data rate variation has the result that the information required to reconstruct a predictively encoded video sequence is not equally distributed amongst the transmitted data packets (*See* Application, page 3, lines 23 - 24). For example, a larger number of packets are required to carry the data related to an INTRA coded frame than are required to carry the data for an INTER coded frame. Furthermore, as the amount of data required to represent consecutive INTER coded frames varies depending on the image content, the number of data packets required to carry INTER frame data also varies (*See* Application, page 3, lines 25 - 29).

In view of this background, the present invention is based on the realization by the inventors that a decoder, e.g. in a receiving client terminal, experiences a variable delay in receiving the information it requires to construct consecutive frames in a video (or other) sequence, even if the transmission delay through the network is constant (*See* Application, page 4, lines 15 - 19). This variation in delay arises due to encoding, packetisation and packet transmission from a server and is independent of, or in addition to, delay jitter that arises due to variations in transmission time within the network (*See* Application, page 4, lines 21 - 25).

Thus, the inventors realized that even in a situation where there is a constant transmission delay in the network, a certain degree of buffering is required in a receiving client device in order to account for the effects of "encoding-related" delay variation.

The resulting invention, as recited in the amended claims, concerns providing a buffering algorithm for buffering media data in a pre-decoder buffer of a client device as well as a corresponding bit-stream verifier for a streaming server, which operate so as to ensure substantially correct playback of media data assuming that the underlying network has constant-delay, reliable transmission properties.

Effectively, this can be viewed as a "minimal condition" for the pre-decoder buffer / streaming system. More specifically, if the size of the pre-decoder buffer is smaller than the minimum pre-decoder buffer size required to accommodate just the encoding-related delay variation for a given data packet stream (the delay variation that occurs when there is no contribution from the network), it will most likely not be possible to play back the media data contained in the packet data stream in a substantially correct manner using a pre-decoder buffer of that (smaller than minimum) size in a network that does not have constant-delay reliable transmission properties. Conversely, if the pre-decoder buffer in the client device has a size equal to the minimum pre-decoder buffer size, substantially correct playback of the media data in a network have constant-delay reliable transmission properties will at least be possible.

It should be noted that although Gunaseelan discloses that an adjustment of packet transmission time can be performed at the server in order to resolve a conflict in packet transmission time-stamps and that knowledge of a client side pre-read size and maximum buffer size can provide an indication of the limits within which adjustment may be

performed, Gunaseelan does not take into account effects on data packet delivery times at the client due to the underlying network. Neither does Gunaseelan provide any teachings relating to client side buffering or server side packet stream verification requirements in view of delay variations that may arise due to encoding of the media data itself.

It is therefore the Applicant's view that Gunaseelan provides no teaching or suggestion relevant to the problem addressed by the present invention, neither to the solution as claimed in the currently amended claims.

At least for the foregoing reasons, Applicants respectfully submit that independent claims 1, 18, 22, 51, 63, 72 and 84 are patentable over the Gunaseelan application. Applicants therefore respectfully request that the rejection of these independent claims be withdrawn. Applicant also respectfully requests that the rejection of the dependent claims be withdrawn, both for the fact that they depend, either directly or indirectly, on allowable base claims, and for reasons attributable to their independently-recited features.

D. Rejection of Claims 17, 19 and 20 under 35 U.S.C. § 103(a)

Applicants respectfully submit that West adds nothing to the disclosure of Gunaseelan to overcome the foregoing arguments. Accordingly, claims 17, 19 and 20 are patentable as depending, either directly or indirectly, from allowable base claims.

Accordingly, Applicants respectfully request that the rejection of these claims be withdrawn.

III. Conclusion

The Applicants submit that in light of the foregoing remarks the application is now in condition for allowance. Applicants therefore respectfully request that the outstanding rejections be withdrawn and that the case be passed to issuance.

Respectfully submitted,

August 3, 2006 — Date

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